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PHILOSOPHICAL TRANSACTIONS.

IX. *Some Observations on the Mode of Generation of the Kangaroo, with a particular Description of the Organs themselves.*
By EVERARD HOME, Esq. F. R. S.

Read March 5, 1795.

THE exertions of the most acute and skilful anatomists have hitherto failed, to explore the process of generation in the quadruped, fully to its origin: I think I may assert, they have ascertained that the embryo comes from the ovarium, and is deposited in the uterus, where it acquires a visible form; but the state in which it leaves the ovarium, the changes it undergoes in the fallopian tube, and its appearance when received by the uterus, are hitherto altogether unknown.

Although we are obliged to confess ourselves ignorant of many things respecting the commencement of generation, the progress of the young from its first visible appearance till it acquires a perfect form, has been very accurately traced; but this may be considered as more properly belonging to the œconomy of the young than to the history of generation itself.

The opossum tribe, which the kangaroo resembles in the structure of its generative parts, differ in the œconomy of their young from other quadrupeds; and as it will be found that this difference is an approach towards the œconomy of animals of another class, the descriptions and observations which are now to be given will be better understood, by stating, in general terms, the different modes employed by nature for supporting the young till it is enabled to receive food by the mouth.

In quadrupeds in general, the ovum containing the embryo, as soon as it arrives in the uterus, becomes attached to the internal surface, and the foetus owes its increase and support to a connection with that viscus, by means of the placenta and navel string.

In the bird, the snake, the lizard, the tortoise, and in fish, the nidus of the embryo, even before its impregnation, is detached from the mother, and the foetus receives its future support from the animal substance in which it is enveloped.

In some of these, the egg which contains the young is deposited in the oviduct of the mother, and there hatched; in others it leaves the oviduct altogether, and is hatched out of the body; but in all cases of detached foetuses, before the young leaves the shell, the remaining contents of the egg pass up into the belly, which is immediately closed after it comes into the air, and therefore there is no appearance of external connection similar to the navel in quadrupeds.

In the following account, the foetus of the opossum tribe will be found neither to derive its support from a connection with the uterus in which it is deposited, like other quadrupeds, nor exactly to resemble in the mode of its nourishment the young that is hatched from an egg, but to have a mode of

support peculiar to itself. It therefore appears to form a link in the gradation leading from the one to the other.

The American opossum, which is a small animal, was the only one of this tribe that was known in Europe before the late discoveries in the South Seas; and as it had not been found to breed either in France or England, the only accounts of its mode of generation were those received from America, which were vague, and could not be entirely depended on.

These accounts, however, led anatomists, who had opportunities of dissecting the female organs, to endeavour by that method to throw some light upon the subject; but the parts were found to be so complex, and in so many respects different from those of other quadrupeds, that nothing satisfactory could thus be made out, while deprived of an opportunity of seeing them in an impregnated state.*

The discovery of the kangaroo, an animal of a very large size, related in many important points to the opossum, opened a prospect of something more satisfactory being ascertained respecting the generation of these animals; and from the time that a colony was established in New South Wales, it became an inquiry to which several persons directed their attention.

The late Mr. HUNTER had for many years kept American opossums, with the sole view of investigating this subject; but

* In BUFFON's *Histoire Naturelle* there is an anatomical description of the female organs of the opossum, by DAUBENTON, and quotations from an account published in England by TYSON, from which he differs in some particulars; but candidly confesses himself not satisfied upon the subject, being unable to make out the uses of the parts. TYSON says there are two ovaria, two tubæ fallopianæ, two uteri, two cornua uteri, two vaginæ uteri. BUFF. *Hist. Natur.* Tom. X. p. 302.

was never able to induce them to breed, although all means in his power were employed for that purpose.

This disappointment did not at all abate his ardour; but finding that little was to be expected in that way, he applied to Captain PATERSON, and Mr. LANG a surgeon, who were going to Port Jackson, having received appointments on that establishment, to give him their assistance. He requested they would procure the female organs of the kangaroo under all the different circumstances in which they occurred, and send them to England in spirits, that he might be enabled to prosecute this inquiry. The only preparations of this kind which arrived before Mr. HUNTER's death, were such as shewed the uterus in its unimpregnated state; and Mr. HUNTER's time was so much occupied by his public appointments that he had not sufficient leisure to examine them.

In the course of the last summer, I have received from Mr. LANG, by the hands of Mr. CONSIDAN, and Major NEPEAN, several preparations of the uterus in different states, and the young kangaroo at a very early period after leaving the uterus. These, on examination, appear to compose a body of evidence that elucidates several parts of the curious mode of generation of this animal, and to contain the most material anatomical facts that are necessary to direct our future inquiries.

The preparations themselves I have deposited in the collection for which they were originally intended; and am desirous to communicate the facts and observations to this learned Society, that they may prove useful to those gentlemen whose residence in that country enables them to prosecute, and complete, this interesting investigation.

The only general circumstances I have been able to collect

respecting the breeding of the kangaroo, from those who have resided in New South Wales, are the following. That they breed at all seasons; that the female has never been known to have more than a single young one at a time, and is seldom found without one. That the young remains in the false belly, or goes into it occasionally, and sucks the mother a long time after it appears capable of procuring its own food; and yet if the mother is closely pursued, in attending to her own safety, she forces the young out of the false belly, if it has arrived at a sufficient age to be covered with hair, although incapable of making its escape.

There are two male and several female kangaroos at the royal menagerie at Richmond, and two or three of the females have bred since they came there. I have visited them at different times, with a view to obtain further information upon this subject, but have been able to do little more than confirm what has been already related.

None of them have had a young one oftener than once in twelve months; and the young appears to be nine months old before it leaves off entirely sucking the mother. One of the females bred at Richmond had a young one in the false belly when only about a year and half old. The young, after it is excluded from the false belly, and another is deposited in it, continues to put in its head and suck for a month or two.

When the female is in heat, the males have no jealousy respecting one another; for a female having been covered by one of the males when the other was present, went directly and was covered by the other.

The male is retromingent; but when the penis is erect it changes its direction, and comes forwards, as in most other ani-

mals; it is of considerable length, and tapers towards the end of the glans, which is extremely small, and pointed. The testicles are contained in a very pendulous scrotum, situated upon the belly, before the penis; the scrotum is more commonly drawn up to the abdominal muscles, but at other times it hangs down several inches in length; this appears to be one of the effects of the animal's desires, at least it was so in one of the male kangaroos at the menagerie at Richmond; for when the animal was at rest the scrotum was drawn up, but when the penis was brought into the state of erection, the scrotum became extremely pendulous.

In the female, the external parts of generation are situated close to the anus, there being one common verge of the external skin to both these canals, which are only separated from one another by means of a septum of no considerable thickness. This common verge of the external skin projects above two inches beyond the bones of the pelvis, and admits of a good deal of motion.

From this structure, both in the male and female, it is evident that they copulate in the same way as most other quadrupeds.

In giving an anatomical description of the female organs of the kangaroo, I shall, with a view to avoid unnecessary detail, describe them first in their most natural, or unimpregnated state, and afterwards take notice of the changes they undergo during pregnancy, and in the time of parturition. In this description I shall be the less minute, as accurate drawings of the parts are annexed, which will explain whatever may appear to be deficient in the description.

At the external orifice of the vagina is situated the clitoris,

which when compared with the size of the other parts may be said to be large, and is covered by a præputium. A little way further on in the vagina are two orifices, which are the openings of the ducts of COOPER'S glands. The vagina itself is about an inch and half in length, beyond which it is divided into two separate canals, and on the ridge which lies between them opens the meatus urinarius leading to the urinary bladder.

These two canals are extremely narrow for about a quarter of an inch in length, and their coats at this part very thick, but afterwards they become more dilated; they diverge in their course, and pass upwards for nearly four inches in length; they then bend towards each other, so as to terminate laterally in the two angles of the fundus of the uterus, of which they appear to be an uniform continuation.

The uterus itself is extremely thin and membranous in its coats, infundibular in its shape, and situated in the middle space between these canals; it is largest at its fundus, and becomes smaller and smaller towards the meatus urinarius, where it terminates; the uterus at that part in the virgin state being impervious.

The same internal membrane appears to be continued over the inner surface of the uterus and lateral canals; it is thrown into several folds, forming longitudinal projecting ridges; one of these constitutes a middle line, extending the whole length of the uterus, and dividing it into two equal parts.

The ovaria, as well as the fimbriæ, both in appearance and situation, resemble those of other quadrupeds; the fallopian tubes follow nearly the same course to the uterus, but a little way before they reach it they dilate considerably, forming an oval cavity; the coats of this part are also much thicker than

those of the rest of the canal, and they are supplied with an unusual number of blood-vessels, giving these cavities a glandular appearance. The fallopian tubes, after having formed these oval enlargements, contract again, and pass perpendicularly through the coats of the uterus at its fundus, and terminate in two projecting orifices, one on each side of the ridge formed by a fold of the internal membrane.

In the impregnated state, these parts undergo a considerable change; in one of the ovaria there is distinctly to be seen a corpus luteum; the ovaria become more vascular, as well as the oval dilatations of the fallopian tubes, which are also enlarged.

The uterus, and two lateral canals, have their cavities very much increased in size, but that of the uterus is the most enlarged: the communication between these canals and the vagina is completely cut off, by the constricted parts close to the vagina being filled with a thick inspissated mucus; and in this state of the parts there is an orifice very distinctly to be seen, close to the meatus urinarius, large enough to admit a hog's bristle, leading directly into the uterus, where in the virgin state no such passage could be observed.

The uterus and lateral canals are uniformly distended with an animal gelly, somewhat resembling the white of an egg; but the parts having been preserved in spirits during a long voyage, this substance must have lost considerably of its natural appearance.

In the cavity of the uterus I detected a substance, which appeared organized; it was enveloped in the gelatinous matter, and so small as to make it difficult to form a judgment respecting it; but when compared with the foetus after it becomes attached to the nipple, it so exactly resembled the

back-bone with the posterior part of the skull, that it is readily recognized to be the same parts in an earlier stage of their formation.

I had an opportunity on the 22d of August, 1794, of reading these observations, and shewing the annexed drawings, to Mr. CONSIDEN, who was seven years an assistant surgeon to the general hospital in New South Wales, and who had paid much attention to this subject. During his residence in that country, he met with the uterus of the kangaroo in its enlarged state, three different times; in all of these the degree of distension was nearly the same; the gelatinous matter contained in the uterus, examined immediately after death, was of a bluish-white colour, in consistence like half-melted glue, and so extremely adhesive as to be with difficulty washed off from the fingers; the internal membrane of the uterus was very vascular, and even more so than that of the lateral canals. The oval enlargements of the fallopian tubes contained a gelly similar to that found in the uterus, but thinner in consistence. He found also the other appearances which I have already described, but in only one of them was the foetus sufficiently advanced to be detected, and that resembled the back-bone delineated in one of the annexed drawings.

Immediately after parturition, the parts are nearly brought back into their original state; the only circumstance deserving of notice is, that the opening leading directly from the uterus to the vagina, which is not met with in the virgin state, after being enlarged by the passage of the foetus, forms a projecting orifice, and almost wholly conceals the meatus urinarius.

Were we to consider the uterus and its appendages in the

unimpregnated state, the two lateral canals would appear to be the proper vaginae, particularly as they begin at the meatus urinarius, which is commonly placed at the entrance of the proper, or true vagina, and receive the penis in coition, the end of which is pointed to fit it for that purpose ; in some species of the opossum the male has a double glans, each of them pointed, and diverging from the other, so as to enter both canals. But when we find these canals in the impregnated state forming with the uterus one general reservoir of nourishment for the foetus, and all communication during that period between them and the vagina cut off, we are led to consider them more immediately as appendages to the uterus than the vagina.

The female kangaroo has two mammae, and each of them has two nipples ; they are not placed upon the abdominal muscles as in most quadrupeds, but are situated between two moveable bones connected with the os pubis, peculiar to this tribe of animals ; and the mammae are supported upon a pair of muscles which arise from these bones, and unite in the middle between them. The mammae are covered anteriorly by the lining of the false belly, and the nipples project into that cavity ; this covering is similar to the external skin, having a cuticle, and short hair thinly scattered over its surface, except at the root of the nipples, where there are tufts of some length, one at the basis of each.

The mammae are supplied with blood from the epigastric arteries. The mammary branches run superficially under the false belly till they reach the mammae. There is a strong muscle that comes down from the upper part of the abdominal

muscles, and adheres firmly to each of the mammæ; this muscle, when the young is sucking, will prevent the mamma being dragged from its natural situation.

The two bones which lie behind the mammæ deserve a particular description, as they are peculiar to the opossum tribe, and belong to the mammæ, and false belly, having no other apparent use but what is connected with the motion of these parts.

They are about two inches and an half long, are flattened, and at their broadest part measure nearly half an inch; they are attached to a projecting part of the os pubis, fitted for that purpose, just before the insertion of the recti abdominis muscles; this attachment to the pubis is by a very small surface, and admits of considerable motion; they have likewise a connection by a ligament half an inch in breadth, to the ramus of the pubis, which joins the ilium. From their base, which is united to the pubis in these different ways, they become narrower till they terminate in a blunted point. These bones have a pair of muscles inserted into their base, to bring them downwards and outwards; another pair into their blunted extremities to bring them forwards; a pair of broad flat muscles fill up the whole space between them, arising from their inner edge through its whole length; they serve as a sling to support the mammæ, and also to bring the bones towards each other.

Besides these additional bones, and the projection to which they are attached, there is another peculiarity in the structure of the pelvis of the female kangaroo; the two rami of the os ischium which join the pubis, have no notch between them as in other quadrupeds, but form a rounded convex surface of some breadth, projecting considerably forwards; the surface

itself is smooth, like those over which tendons sometimes pass ; but the lateral parts are rough, and have a pair of muscles arising from them inserted into the skin of the false belly, to bring its mouth towards the pudendum.

The mode in which the young kangaroo passes from the uterus into the false belly has been matter of much speculation, and it has been even supposed that there was an internal communication between these cavities ; but after the most diligent search, I think I may venture to assert that there is no such passage. This idea took its rise from there being no visible opening between the uterus and vagina in the unimpregnated state ; but such an opening being very apparent, both during pregnancy and after parturition, overturns this hypothesis ; for we cannot suppose that the foetus when it has reached the vagina can pass out in any other way than through the external parts. That this is really the case, and that in this way it gets into the false belly, is highly probable for the following reasons.

The false belly has muscles to bring its mouth as near as possible to the opening of the vulva, which does not appear necessary for any other purpose than that of receiving the foetus.

The bones belonging to the mammæ and false belly have muscles, which by their action will bring down both these parts towards the vulva, for which no other use can be assigned ; and these parts are so much detached from the abdominal muscles, that this effect can be produced during their action to expel the foetus from the uterus.

The vulva has naturally an unusual projection, and the margin of the pelvis immediately before it, is rounded and smooth,

so as to admit of its moving easily in that direction ; add to this the action of opening the mouth of the false belly, will bring down the skin, and allow the external orifice of the vagina to be thrown still further out, so as to project more directly over the mouth of the false belly in which the foetus is to be deposited.

It is to be observed, that if the parts in their natural state are fitted for such an action, they will be still more so at the period in which it is to be performed ; since in all animals, at that particular time, there are changes going on to facilitate the expulsion of the young in the way most favourable for its preservation.

The size of the foetus at the time it leaves the uterus, I believe, is not ascertained ; but it has been found in the false belly attached to the nipple not more than an inch and a quarter in length, and 31 grains in weight, from a mother weighing 56 pounds. In this instance the nipple was so short a way in the mouth that it readily dropped out, we must therefore conclude that it had been very recently attached to it.

The foetus at this period had no navel string, nor any remains of there ever having been one ; it could not be said to be perfectly formed, but those parts which fit it to lay hold of the nipple were more so than the rest of the body. The mouth was a round hole, just large enough to receive the point of the nipple ; the two fore-paws, when compared with the rest of the body, were large and strong, the little claws extremely distinct ; while the hind legs, which are afterwards to be so very large, were both shorter and smaller than the fore ones.*

* Since writing the above, I have received from Mr. LANG, in the month of March,

When the foetus first adheres to the nipple, the face appears to be wanting, except the round hole to receive it; and as the jaws and lips grow, they cover a greater length of the nipple, giving the mouth a better hold; the upper surface of the tongue, as that organ grows, is concave, adapting it to the nipple which lies upon it. The growth of the foetus is distinctly seen in the annexed drawings.

From the peculiarities in the structure of the female organs of the kangaroo, it is evident they must, in their mode of generation, materially differ from other quadrupeds.

The semen of the male passes in a circuitous way through the lateral canals to the cavity of the uterus, and from the structure of the parts, can neither enter the fallopian tubes, nor readily return to the vagina.

The embryo, in its passage from the ovarium along the fallopian tube, will be enveloped in the gelly formed in the oval glandular enlargement of that canal, and in this state deposited in the uterus, where it will come in contact with the semen of the male.

This differs from other quadrupeds, but exactly coincides with all those animals whose foetuses are detached; the semen being retained in the lower part of the oviduct, where it comes in contact with the egg when completely formed.

1795, a foetus taken from the false belly, smaller than any that had been met with. It weighed 21 grains at the time it was taken from the false belly, and was less than an inch in length. Its fore-paws, while of this size, were equally well formed to appearance as in the foetus above described, and double the length of the hinder ones, but the mouth had evidently less width. The nipple to which it had been attached did not accompany it.

It would seem probable, that the mouth of the foetus is originally attached to the nipple by means of the gelatinous substance contained in the uterus.

In other quadrupeds the influence of the semen is ascertained to have reached the fallopian tube, by well attested cases of the foetus never arriving at the uterus. In this animal such an effect is rendered difficult, and not very probable; it is therefore more natural to suppose the impregnation takes place in the same way as in the detached foetuses of other animals.

This mode of nourishing the young resembles, in some respects, what takes place in the dog-fish, whose egg is deposited in the oviduct, and hatched there. The yelk of the egg in the bird being conveyed into the belly at the time of its being hatched, made me desirous to see if any of the gelatinous substance of the uterus was conveyed into the belly of the young kangaroo, but I could not on dissection find any such appearance; and as it is to be immediately attached to the nipple, there is no apparent necessity for such a provision.

The egg of the turtle and dog-fish, which live in water, is similar to the contents of the uterus in the kangaroo in being composed of one substance only, which renders it probable that in birds it is made up of two substances, on account of the young being longer unable to procure its own food.

If we consider the varieties which occur in the formation of different animals as so many parts of the same system, the mode of generation just described will be found, in this chain of gradations of nature, to form a link between animals whose young are nourished by means of a connection with the uterus, and those that are nourished independant of it.

EXPLANATION OF THE PLATES.

Tab. XVIII.

Fig. 1. a posterior view of the uterus, and its appendages, the rectum being removed. The parts are represented of their natural size.

a, the clitoris, inclosed in its præputium.

b b, the ducts of COOPER'S glands.

c c, the internal surface of the vagina.

d, the meatus urinarius.

e e, the canals leading from the vagina to the uterus.

ff, two natural constrictions in the canals.

g g, the canals terminating in the uterus.

h h, the uterus, seen through the membrane to which the lateral canals are attached.

i i, the fallopian tubes, forming two oval swellings before they enter the uterus.

k k, the course of the fallopian tubes.

l, the ovarium of one side, slit open.

m, the other ovarium, with the fimbriæ spread over it.

n n, the ureters, passing to the bladder behind the uterus.

Fig. 2. the false belly, of its natural size in the virgin state, containing the two mammæ, each of them having two nipples, scarcely projecting above the surface. The lining of the bag has a dark-coloured cuticle, thinly covered with short hair, except at the root of the nipples, where there are tufts of some length.

Tab. XIX.

Fig. 1. and 2. represent the vagina exposed in the same manner as in the former drawing, to shew its appearance. The first is during pregnancy; and an orifice is seen close to the meatus urinarius, which leads to the uterus, and is not to be found in the virgin state. In the second, this orifice is so much enlarged as almost wholly to conceal the passage to the bladder; it puts on this appearance immediately after parturition.

Fig. 3. an anterior view of the uterus and its appendages, immediately or a short time after parturition.

a, the portion of the urinary bladder.

b b, one of the canals leading from the vagina to the uterus.

c c, the other canal, laid open.

d d, the cavity of the uterus.

e e, the openings of the fallopian tubes.

ff, a ridge made by a fold of the internal membrane.

g, the remains of a corpus luteum in the ovarium.

b, an uncommon number of blood-vessels going to the oval glandular enlargement of the fallopian tube.

i i i i, the ureters, terminating in the bladder.

Tab. XX.

Fig. 1. the foetus of a kangaroo found in the false belly, represented of its natural size; weighing only 21 grains, and the smallest that has been ever discovered. It is probably in the earliest state; as the mouth had little if any hold of the nipple.

Fig. 2. the part of the foetus found in the impregnated uterus.

Fig. 3. the foetus, after having become attached to the nipple.

Fig. 4. the nipple, to show how far it had been in the mouth.

Fig. 5. the foetus a little further advanced, and the tongue, concave on its upper surface, adapted to the nipple.

Fig. 6. the foetus still larger, the hind legs having acquired their natural proportion to the other parts.

Tab. XXI.

A view of the pelvis of the natural size, to show the situation of the two bones belonging to the false belly.

a a, the two bones, one in its most common position, the other bent down, to show the extent of its motion.

b, the projection of the bones of the pubis, on which the two small bones move.

c, a ligament, connecting the small bone to the ramus of the os pubis.

d, a projecting rounded convex surface, over which the pudendum is brought forward, to allow of the foetus being deposited in the false belly.

Fig. 1.

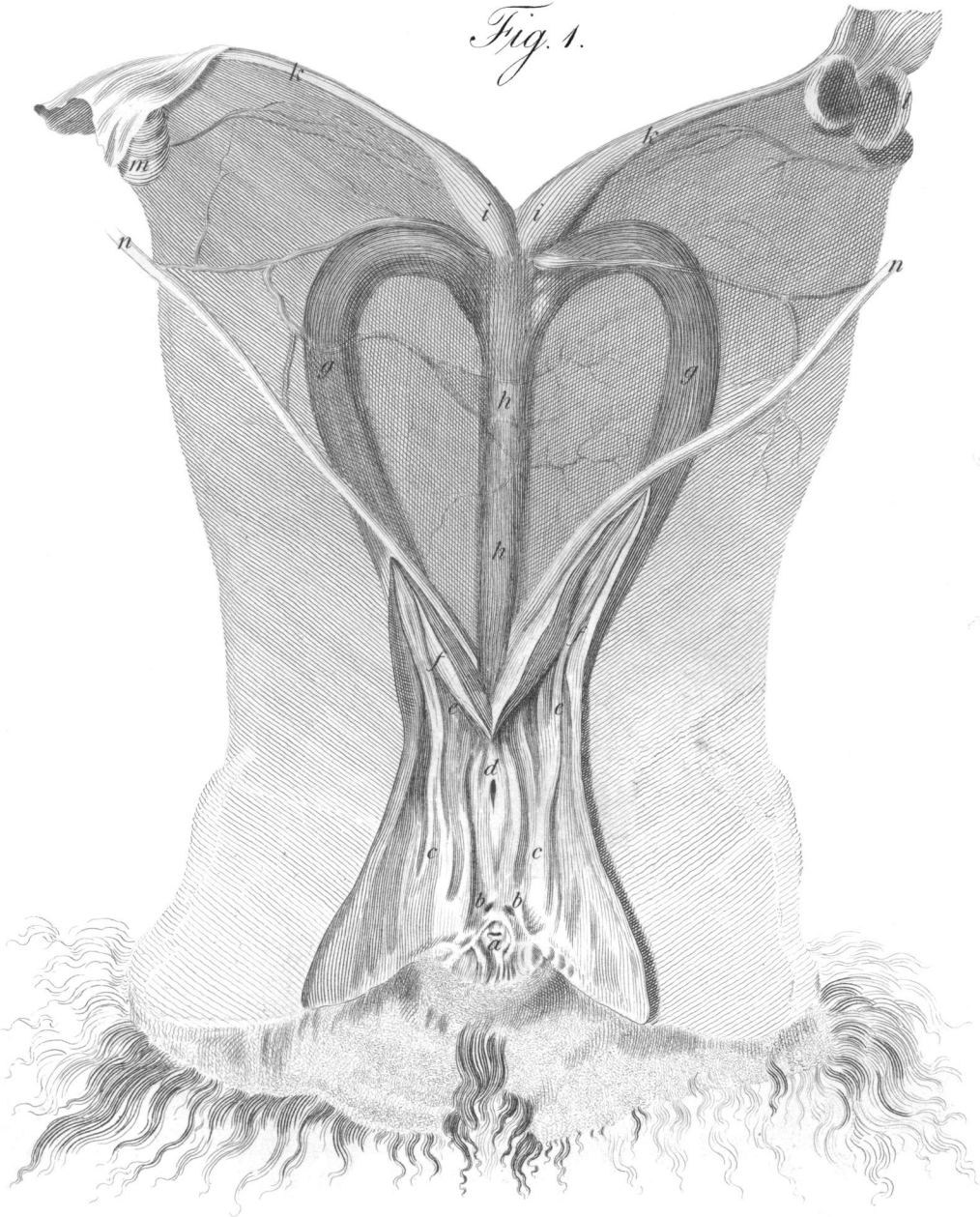


Fig. 2.



Fig. 1.

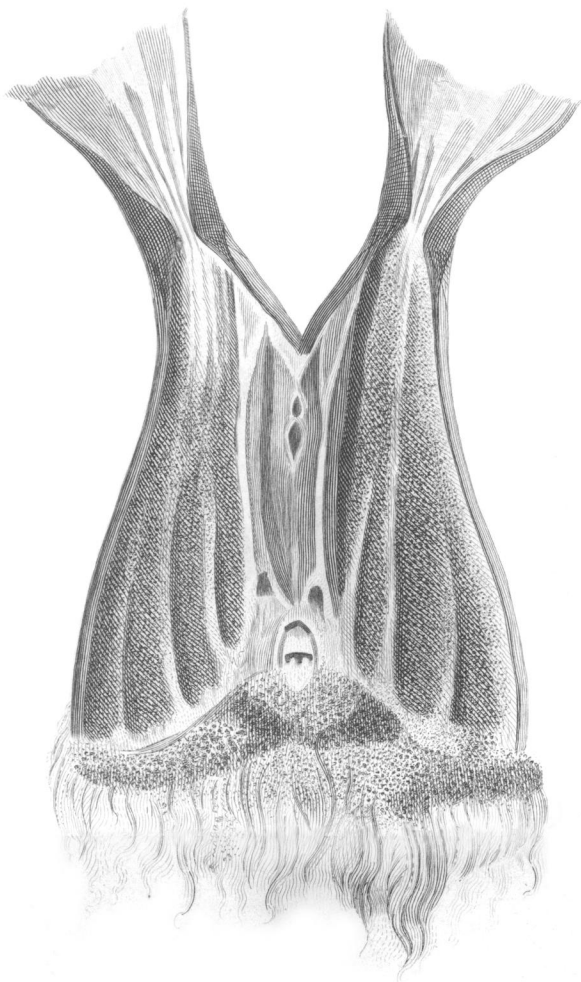


Fig. 2.

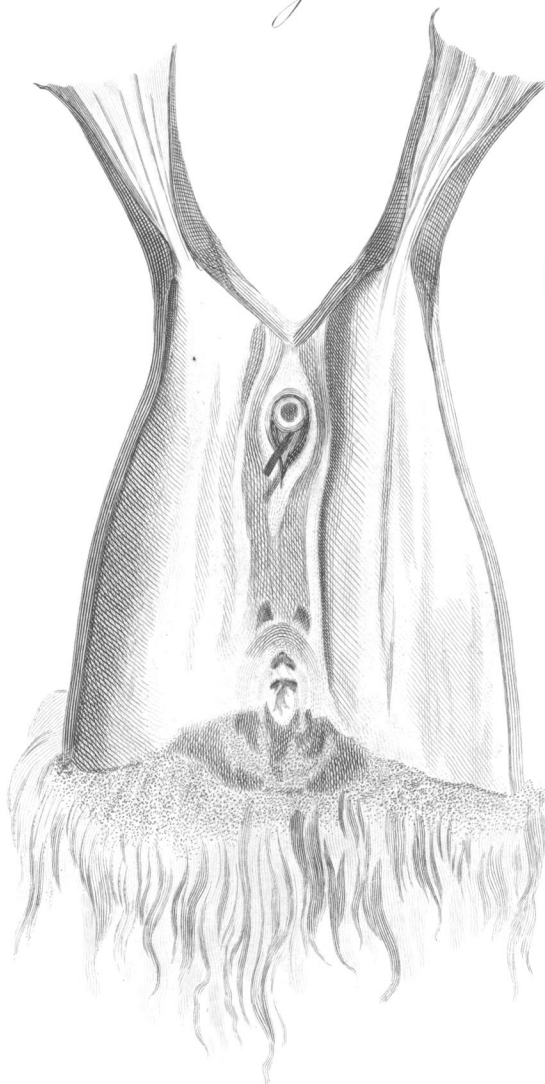


Fig. 3.

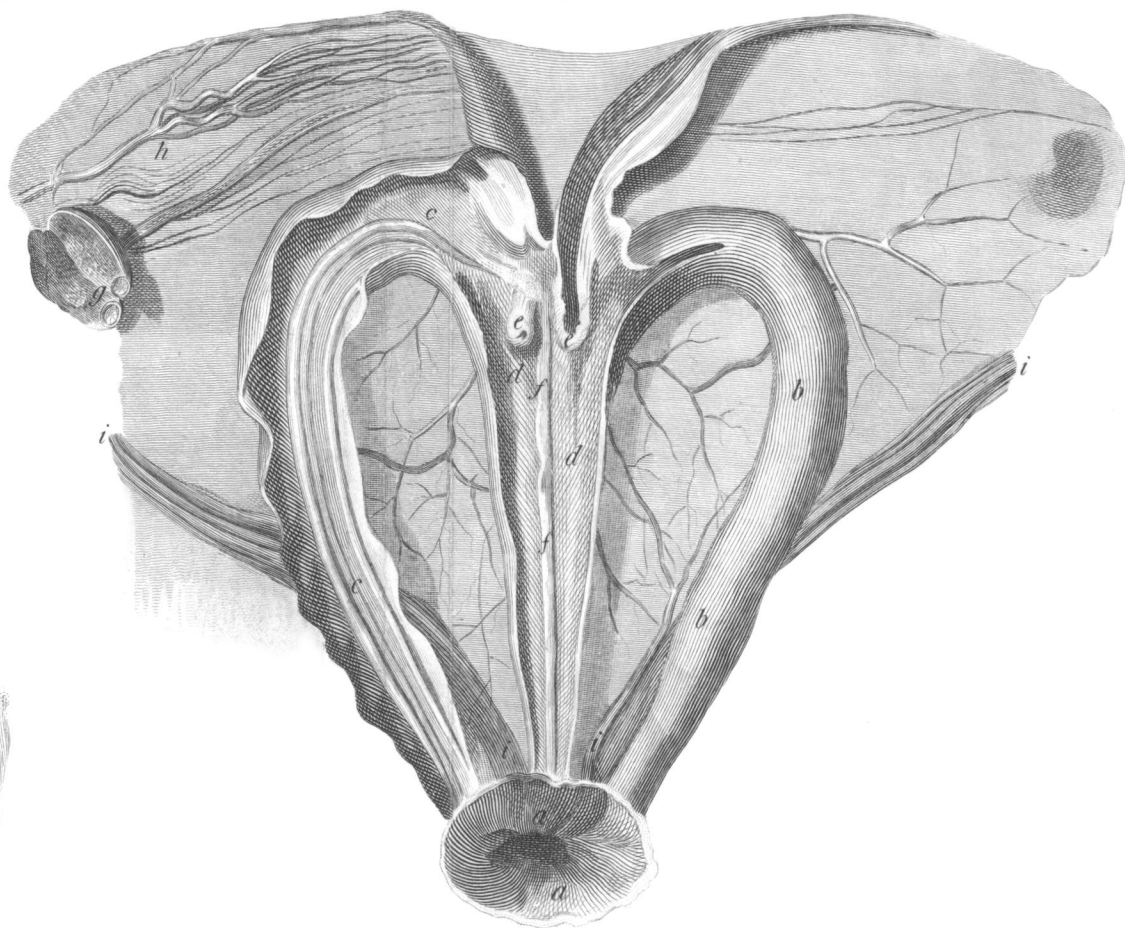


Fig.

1



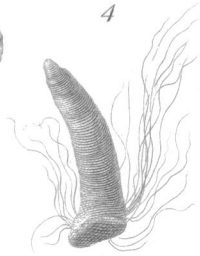
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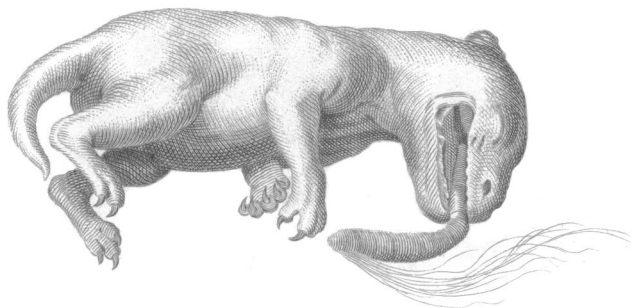
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